

Squirrel Chatter II

Shale Gas Returns, Transforming the Energy Outlook

2nd Quarter 2011

Just five to seven years ago, it was widely believed that North American natural gas resources were being rapidly depleted. Today, the outlook appears to be very much improved thanks to the ingenuity of a few individuals and a process that should provide natural gas for decades to come.

In 1825, some 34 years before Colonel Edwin Drake¹ drilled the first oil well in Titusville, Pennsylvania, William Aaron Hart drilled the first natural gas well, in shale located in Fredonia, New York. By August of that year, five structures in the village were illuminated by natural gas and by November there were 36 gas lights in the village. In 1857, Preston Barmore, the superintendent of the Fredonia Natural Gas Co., was not satisfied with the production from a 122 foot well so he exploded crevices of rock in the well, increasing the supply of gas. Within a few years, the village had 150 gas lights.²

Plenty of natural gas was subsequently found in sandstone formations under impermeable rock, in similar formations as oil, or accompanied by oil. Extracting this natural gas was less costly than drilling for gas in shale, so shale exploration all but ended. Over 300,000 miles of gas pipeline were built, and demand for natural gas grew.³ U.S.-marketed production rose to 1 trillion cubic feet (TCF) of natural gas by 1923, and has ranged from 16.9 to 22.6 TCF since 1973.⁴ Natural gas is used for heating and manufacturing, and is a feedstock for fertilizers, plastics and chemicals.

Recent Natural Gas Shortages

In 2004, Julian Darley wrote *High Noon for Natural Gas, The New Energy Crisis*. He reviewed Hubbert's Peak, a theory named after the geologist who researched oil finding and production curves and then correctly predicted that U.S. oil production would peak around 1970. Darley applied Hubbert's Peak to natural gas data and concluded that North American gas production had also peaked and was likely to plunge.

Darley wrote, "The United States and Canada are entering a natural gas crisis ...North American supply is simply no longer able to meet desired consumption."⁵ He added, "...the worst immediate problem confronting the United States (and Canada) is not oil, but natural gas. It is a natural gas shortage that could seriously interrupt the U.S. economy..."⁶ Darley noted that the U.S. Energy Information Administration (EIA) made enormous upward revisions for production of natural gas from shale, tight sands and coal beds, but he believed such gains would fail to

occur. Instead, importing of liquefied natural gas (LNG) would have to be an interim solution. But LNG, Darley stated, had safety and security risks. Geopolitically, relying on imported LNG would also be problematic, as Russia and Iran had the largest reserves of natural gas.

Darley believed that the 300-plus new natural gas-fired electric generating stations, built between 1980 and 2003 at a cost of \$100 billion, were huge mistakes. The power companies had apparently reviewed a 1999 National Petroleum Council report that stated North American natural gas supplies would grow. Darley labeled that report as an “example of the kind of cornucopian delusion that characterizes many in government and most in industry, who believe in nothing but economics and the miracle of capitalism with its unlimited ability to find substitutes for everything.”⁷

Darley thought that with worldwide Peak Oil imminent and North American natural gas production plunging, energy was to become scarce, and the industrial revolution would unwind. He advocated that people should be able to obtain their daily needs within walking distance from where they lived. His long-term solution was to depopulate the earth, such that mankind no longer mined the planet and consumed only the energy that the sun regularly provides. At one child per woman, the population of the earth would be back to one billion in about 100 years.

Domestic natural gas production fell between 2001 and 2005 and prices increased between 2002 and 2008.⁸ Most major oil companies and analysts agreed that natural gas production in North America was peaking, and that the United States would need substantial imports of LNG. I remember going to an energy conference in early 2006 where this view was widespread. Darley’s nightmare scenario seemed to be coming true.

Back in the Gas Fields

George Mitchell has been called the Father of the Barnett Natural Gas Field, located in and around Fort Worth, Texas. Over an 18-year period beginning in 1981, his company, Mitchell Energy and Development, experimented with fracturing gas-bearing shale that is located between 6,000 and 14,000 feet below the surface. Geologists knew that shale had lots of pores and the ability to store natural gas, but since pores in shale are rarely interconnected, gas flows poorly through shale. Initial attempts to extract this gas were costly, and production was not economical. Eventually, the company developed a “light sand frac” method that was effective and used less fluid. The combination of reduced costs and rising natural gas prices made such drilling profitable. Mitchell drilled many wells at the Barnett field, producing far more natural gas than most people expected.⁹

Mitchell needed more funding and sold his company to Devon Energy, a larger, independent producer. Devon had expertise in an additional technology, horizontal drilling, which tilted drill holes at angles or sideways once they hit pay dirt. More gas-bearing shale was consequently exposed to the well. With this added technology, the company drilled 55 wells in the Barnett field in 2003 and the shale gas boom began.¹⁰ Some 13,500 gas wells have been drilled in

the Barnett field since 1997¹¹ and the Barnett field accounted for 6% of total natural gas production in the United States in 2010.¹²

Drilling at other shale gas formations has also jumped. U.S. shale gas production increased 12-fold in the last decade and currently accounts for about 25% of U.S. natural gas production.¹³ With greater production, natural gas wellhead prices halved from 2008 to 2010. In its yearly forecast in 2010, the EIA doubled its estimate of U.S. shale gas production for 2035 and predicts shale gas production will hit 46% of U.S. consumption that year.¹⁴ Imports will drop from 11% of natural gas consumption in 2009 to 1%.¹⁵ With “economics and the miracle of capitalism,”¹⁶ we won’t need to revert to Darley’s dark ages any time soon. The EIA also believes shale gas totaling at least six-times U.S. reserves is recoverable in at least 32 other countries.¹⁷

Energy Mix

In 2009, Robert Hefner published *The Grand Energy Transition*. The book provides perspectives on past and future sources and uses of energy. Hefner believes that energy usage naturally transitions from solids (wood and coal) to liquids (oil) and then to gasses (natural gas, wind and hopefully nuclear fusion). He sees newer fuels as superior to older ones, with each new fuel facilitating new technologies, improvements in the environment and higher living standards.

The transition to coal from wood powered the industrial revolution and allowed millions of acres of forests to regrow. Coal then fell from 80% of the world energy market in 1900 to about 28% currently. Oil ascended to 48% of the world’s energy by 1973, displacing much dirty coal and revolutionizing transportation via the introduction of automobiles and airplanes. Oil subsequently dropped to about 36% of world energy consumption. Natural gas has risen from 10% of the world’s energy in 1950 to 24% currently.¹⁸

Believing in global warming, Hefner notes that the transition from wood to coal to oil to natural gas slashed carbon content and increased hydrogen content of fuels with each transition. Since burning carbon creates carbon dioxide (CO₂), the primary greenhouse gas, and burning hydrogen creates water, the natural transitions from solids to liquids to gasses slow global warming. Burning natural gas creates 44% less CO₂ than burning coal and 29% less than burning oil. Burning natural gas also emits about 80% less nitrogen oxides, over 90% lower particulates and over 99% less sulfur dioxide than coal or oil.¹⁹

Under an earlier belief that the United States was running out of natural gas, the Natural Gas Policy Act (NGPA) and the Fuel Use Act were passed in 1978. The NGPA immediately deregulated prices for gas produced from deep wells and phased out other price controls.²⁰ The Fuel Use Act mandated the phase out of natural gas for electric generation and restricted its industrial uses. Prices for deep gas jumped, but so did drilling. Production grew, and with demand depressed by the Fuel Use Act, prices then collapsed. There was an excess supply of natural gas, known as the “gas bubble,” until the year 2000.

Hefner believes that prior price controls and the Fuel Use Act slowed the natural transition from coal and oil to natural gas. As a result of the Fuel Use Act, some 100,000 megawatts of

coal-fired electric generating capacity was built in the United States through 1989 that has emitted 15 billion metric tons of CO₂ into the atmosphere.²¹ Hefner believes that the construction of the coal burning plants, not the natural gas burning plants, was the big mistake. Hefner subscribes to Peak Oil occurring soon, but sees many decades of abundant and relatively cheap natural gas. Hence, he predicts the grand energy transition to natural gas will continue, and he believes natural gas will be a bridge fuel to renewable energy and possibly nuclear fusion. Natural gas complements wind energy quite well, as gas-burning electric plants can quickly power up when the wind slows.

Some 12 million vehicles worldwide are powered by natural gas. Of that number, there are estimated to be 110,000 natural gas-powered vehicles in the United States,²² including thousands of trucks serving the ports of Long Beach and Los Angeles,²³ more than 11,000 buses²⁴ and approximately 12,000 Honda Civic GX cars.²⁵ These vehicles burn natural gas currently priced at one-third of the energy equivalent price of oil. Hefner believes that half the autos in the United States should be powered by natural gas, and the dirtiest, coal-burning electric plants should be replaced by natural gas plants. Yearly gas consumption would rise by 13 TCF, but could be met by increased shale gas production.²⁶

Investment Implications

We believe that innovations in producing gas from shale have indeed transformed the U.S. energy outlook. We profitably invested in some of the pioneers of shale gas though, with the current glut of natural gas, the stocks now look less attractive. Supplies of gas may remain high in the short term as some unprofitable drilling persists in order to keep lease rights. Over time, the low prices will likely result in reduced drilling and more constrained supplies. When this happens, natural gas prices should rise to a level where drilling and production are moderately profitable. We continue to look for suppliers and service companies participating in shale gas production. Some shale *oil* fields are now being developed, including the Bakken field in North Dakota and Canada and the Eagle Ford field in Texas. At this point, we don't think there will be enough shale oil production to revolutionize the oil market, but we do believe we have found some attractive stocks participating in those developments.

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on numerous factors, may not be relied on as an indication of trading intent on behalf of any particular Columbia Acorn Fund.

¹ Colonel Edwin Drake was an American oil driller, credited with being the first to drill for oil in the United States.

² Lash, Eileen and Gary, "The Early History of Natural Gas, Kicking Down the Well," The SUNY Fredonia Shale Research Institute, June 3, 2011, <http://www.fredonia.edu/shaleinstitute/history.asp>.

³ U.S. Energy Information Administration (EIA), http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/index.html.

⁴ EIA data, including imports primarily from Canada, states the U.S. has been using about 23 trillion cubic feet (TCF) of gas a year, including about 6.6 TCF for industrial purposes. www.eia.gov.

⁵ Darley, Julian, *High Noon for Natural Gas, The New Energy Crisis*, (White River Junction, Vermont, Chelsea Green Publishing Company 2004) p. 13.

⁶ *Ibid.*, p. 2.

⁷ *Ibid.*, p. 79-80.

⁸ According to EIA data, domestic natural gas production fell from 20.6 TCF in 2001 to 18.9 TCF in 2005. Average annual wellhead prices rose from \$3 to \$5 in 2002-2003 to \$6 to \$8 from 2006-2008. www.eia.gov.

⁹ Airhart, Marc, "The Father of the Barnett Natural Gas Field," <http://geology.com/research/barnett-shale-father.html>.

¹⁰ Yergin, Daniel, "Stepping on the Gas," *Wall Street Journal*, April 2, 2011.

¹¹ Presentation for the Organization of Economic Cooperation and Development (OECD), "Shale Gas and the Outlook for U.S. Natural Gas Markets and Global Gas Resources," June 21, 2011, http://www.eia.gov/pressroom/presentations/newell_06212011.pdf.

¹² U.S. Department of Energy, Office of Fossil Energy and National Energy Technology Laboratory, "Modern Shale Gas, Development in the United States: A Primer," April 2009, p. ES-1, http://fossil.energy.gov/programs/oilgas/publications/naturalgas_general/Shale_Gas_Primer_2009.pdf

¹³ Presentation for the Organization of Economic Cooperation and Development (OECD),

“Shale Gas and the Outlook for U.S. Natural Gas Markets and Global Gas Resources,” June 21, 2011, http://www.eia.gov/pressroom/presentations/newell_06212011.pdf.

¹⁴ Lomax, Simon, “Shale-Gas Output May Double by 2035, Reducing Energy Imports, U.S. Says,” Bloomberg, December 16, 2010, <http://www.bloomberg.com/news/2010-12-16/natural-gas-production-from-shalemay-double-by-35-u-s-agency-forecasts.html>.

¹⁵ Presentation for the Organization of Economic Cooperation and Development (OECD), “Shale Gas and the Outlook for U.S. Natural Gas Markets and Global Gas Resources,” June 21, 2011, http://www.eia.gov/pressroom/presentations/newell_06212011.pdf.

¹⁶ Darley, Julian, op. cit., p. 79-80.

¹⁷ Presentation for the Organization of Economic Cooperation and Development (OECD), “Shale Gas and the Outlook for U.S. Natural Gas Markets and Global Gas Resources,” June 21, 2011, http://www.eia.gov/pressroom/presentations/newell_06212011.pdf.

¹⁸ Hefner III, Robert A., *The Grand Energy Transition*, (Hoboken, New Jersey, John Wiley & Sons, Inc. 2009) p. 27.

¹⁹ U.S. Department of Energy, Office of Fossil Energy and National Energy Technology Laboratory, “Modern Shale Gas, Development in the United States: A Primer,” April 2009, p. 5, http://fossil.energy.gov/programs/oilgas/publications/naturalgas_general/Shale_Gas_Primer_2009.pdf

²⁰ Hefner III, Robert A., op. cit., p. 120-121. Having been an independent explorer for natural gas, Hefner was well aware that gas existed in locations independently of oil. (He has been called the “Father of Deep Natural Gas” as his company drilled very deep wells finding only natural gas at very high pressure.) In the 1970s when geologists for major oil companies testified to Congress that the U.S. was running out of natural gas, Hefner dissented, believing that the shortage was caused by price controls in place since 1954. Price controls cause shortages of valuable commodities by boosting demand and restraining supplies.

²¹ Ibid., p. 122.

²² Natural Gas Vehicles of America, <http://www.ngvc.org/mktplace/index.html>. Accessed July 20, 2011.

²³ Hefner III, Robert A., op. cit., p. 201.

²⁴ Natural Gas Vehicles of America, <http://www.ngvc.org/mktplace/index.html>. Accessed July 20, 2011.

²⁵ Oberman, Mira, "The Greenest Car You've (Likely) Never Heard Of," *Agence France-Presse*, April 11, 2011.

²⁶ Hefner III, Robert A., op. cit., p. 203.

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